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TECHNICAL NEWS BULLETIN

OF THE BUREAU OF STANDARDS

Subscription, 25 cents a year (U. S.), 40 cents a year (Foreign). Address
"Superintendent of Documents, Washington, D. C."

Washington, June, 1927—No. 122

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TWENTIETH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

The Twentieth National Conference on the Weights and Measures of the United States was held under the auspices of the Bureau of Standards on May 24 to 27, 1927.

In this country, with one or two exceptions, there are no national laws governing weights and measures. The regulation of such matters is left to the States and municipalities. Such an arrangement has many important advantages but also some serious drawbacks. For instance, there is an opportunity for all sorts of conflicting requirements in various jurisdictions with many attending hardships. The dangers of this situation were fully appreciated by the early officials of the National Bureau of Standards, and it was one of the first problems to which the bureau gave its attention. Although without regulatory power, the bureau believed that by call-

ing each year an informal conference of weights and measures officers from all over the country to discuss their problems with the representatives of the National Government much could be done toward securing uniformity in these matters in the various States and cities.

Accordingly, the first conference was called in 1905. Since that time the conferences have been held each year, except during the war in 1917 and 1918.

The subjects discussed have covered the entire range of weights and measures and have reflected in a most interesting way the growth of certain industries which have brought with them new weights and measures problems. This is particularly true in the case of motor cars. Of late years much time has been given to problems of gasoline-measuring pumps, oil-dispensing methods, wheel-load weighers, and taximeters. A few of the subjects considered by past con-

ferences are the following: Best methods for preventing fraud in selling by weight and measure; salaries versus fees for weights and measures officers; the advisability of having the Bureau of Standards pass upon types of weighing and measuring devices; net container laws; testing of railroad track, industrial, and mine scales; uniform marking of containers; undesirable measuring devices; testing of gas and water meters; uniform weights per bushel; civil service status for officials; testing of glass volumetric apparatus; the Federal apple barrel law; liquid measuring pumps; machine measurement of fabrics; teaching of weights and measures in the schools; sale of bread by weight; specifications and tolerances for leather measuring machines; weighing of commercial vehicles to prevent overloading of highways; tolerances for automatic scales; tests of milk and cream bottles; fraudulent marking of jewelry; specifications for and tests of taximeters; sale of ice cream by weight instead of volume; problems of peddlers and transient vendors; weights and measures conditions in the various States; checking gasoline deliveries; bottles for dispensing lubricating oils; gauging of fuel oil storage tanks; problems of livestock weighing; testing clinical thermometers; and training the prospective housewife in weights and measures matters.

The conference last month was attended by 101 weights and measures officers representing 22 States, Porto Rico, and the District of Columbia. In addition, 79 representatives of manufacturers, 20 representatives of railroad weighing departments, and 25 others interested in weights and measures matters were present, making the total attendance 225.

Addresses were delivered by Dr. Burgess, president of the Conference, and David Lawrence, president of the United States Daily. Twenty special papers on subjects of interest to the conference were read and in many cases were followed by a thorough discussion. This open threshing out of weights and measures problems by State officers, manufac-

turers, and representatives of the Federal Government is one of the most valuable features of these meetings.

Among the subjects considered were: Department store control of fabric measurement; the use of the plate fulcrum principle in the construction of high-capacity scales; regulating sales of fruit; testing standards of length; weights in the sugar and tobacco industries of Porto Rico; model weights and measures law; regulating new types of devices; dispensing greases and similar products; lubricating oil bottles; transmission drive for taximeters; gasoline pumps; marked weights of hams; scoring machines for ice; and methods for the sale of ice cream.

Some of these matters were carried over from the last conference, notably the methods of selling ice cream and methods of driving taximeters. The present conference went on record as favoring sales of ice cream on a volume rather than a weight basis, but with strict regulation on the "overrun." In the case of taximeters it is claimed that the shaft drive has many advantages over the old front-wheel drive and does not result in overcharging. It was felt that the Bureau of Standards should conduct tests of actual instruments in service to determine just what points ought to be covered in a specification for taximeters, and the conference voted that such a program be carried out. The paper on the scoring of ice caused much interest and discussion. Apparently this method of partially cutting the large blocks into cubes suitable for sale at house doors has disposed of the short-weight ice problem in Cleveland. Action was taken favoring an allowance for shrinkage from the marked weight of hams, thus insuring to the purchaser payment only for actual weight received. The description of the plate fulcrum principle as applied to high-capacity scales for weighing locomotives and freight cars marks an important step forward in scale design.

At the final session of the conference on May 27 the following officers were elected for the coming year:

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President: George K. Burgess, Director, Bureau of Standards.

First Vice President: J. Harry Foley, superintendent of weights and measures, State of New Jersey.

Second Vice President: H. S. Flurry, chief, division of weights and measures, State of Alabama.

Secretary: F. S. Holbrook, cochief, weights and measures division, Bureau of Standards.

Treasurer: George F. Austin, sealer of weights and measures, City of Detroit.

Executive Committee: George K. Burgess, J. H. Foley, H. S. Flurry, F. S. Holbrook, G. F. Austin, Fred Benjamin, W. F. Cluett, H. N. Davis, Thomas Flaherty, William Foster, W. F. Goodwin, S. T. Griffith, T. F. Mahoney, E. J. Maroney, I. L. Miller, G. B. Nebinger, W. A. Payne, P. T. Pilon, B. W. Ragland, G. M. Roberts, A. W. Schwartz, W. F. Steinel, and H. A. Webster.

NEW ECONOMICS OF BUSINESS

Keen competition, a constantly declining price level, and capacity that can easily cause production to run ahead of consumption are three forces now attacking profits in various lines of manufacturing.

Competition is not only keen between individual companies within the same industry but also between entire industries. Manufacturers having a certain

product in common are seeking as a group to win the consumers' favor over another group having common interest in another product. Installment selling has intensified this "new competition."

Declining price levels have increased the problems of the manufacturer caught between the upper millstone of consumer resistance to further rise in the cost of living, and the nether millstone of pressures to maintain current high-wage levels, to meet the higher costs for materials, equipment and supplies (arising out of intense demand and threatened shortages), and to absorb the higher costs of doing business. "Hand-to-mouth" buying has thrown the costs of carrying heavy inventories onto the manufacturer.

Capacity beyond that required to satisfy the current rate of consumption encourages effort to increase that rate, yet circumstances operating to cut the current rate of consumption would obviously render idle much of the capacity now operating. And there is therefore a question as to whether effort to force consumption for the sake of taking up present slack will not seriously jeopardize the capacity now being utilized effectively.

Review of "Statistics of Income" by the United States Bureau of Internal Revenue for 1922-1925, inclusive, shows a steadily declining profit margin as follows:

Year	Corporations reporting	Number making profit	Profit	Gross income (millions) A	Net income (millions) B	Profit margin B/A
			<i>Per cent</i>			<i>Per cent</i>
1922	382,833	212,535	55.5	\$80,331	\$6,963	8.6
1923	398,993	233,339	58.5	97,457	8,321	8.5
1924	417,421	236,389	56.6	97,158	7,586	7.8
1925	414,461	244,544	54.2	(?)	9,036	(?)

¹ Incomplete or partial report.

² Not available at this date.

With the above conditions a matter of common discussion among business men, the time was never more favorable for the application of simplified practice and allied waste-elimination measures recommended by the Hoover committee on "waste in industry."

Simplified practice, or the elimination of unnecessary variety in sizes, dimensions, grades, specifications, "line numbers," etc., of commonly used commodities, means smaller inventories, quicker turnover, lower costs of doing business, and greater efficiency in production and

distribution. All of these combine to yield to the consumer good quality and fair price, to the worker good wages and steady work, and to the manufacturer volume business at fair profit.

SIMPLIFIED INVOICE FORMS

During the short period which has elapsed since its promulgation the new simplified invoice has been formally accepted by 12 associations and over 100 important business concerns, as well as by the Federal Specifications Board and other independent groups. Since commercial forms are usually ordered in sufficient quantity to meet requirements for six months to a year or longer, it is appreciated that the new standard will come into general use only as present stocks are exhausted. For this reason the joint committee determined upon a two-year period during which the simplified form is to be subjected to the test of practical use.

NATIONAL COMMITTEE ON WOOD UTILIZATION

The annual meeting of the National Committee on Wood Utilization took place at the Department of Commerce on May 3. The progress of the work which is being carried out through project committees was discussed. At present the national committee has 133 members, representing manufacturers, distributors, and consumers of forest products, in addition to professional groups and cooperating organizations directly interested in wood utilization. Group meetings were held to outline a program to be undertaken during the next 12 months for the following projects: (1) Promotion of the use of short-length lumber, (2) end-matching of lumber, (3) seasoning and handling of lumber, (4) grade marking of lumber, (5) softwood lumber lengths, (6) improved sawmilling practice, (7) small dimension stock, (8) standardization of requirements of industrial consumers, (9) promotion of uses of low-grade lumber, (10) construction manual, (11) preserved wood, (12) containers, (13) survey of nonutilized material, (14) wood chemical studies,

and (15) miscellaneous projects. Progress reports regarding the committee's program will be sent on request to the division of simplified practice, Department of Commerce.

SIMPLIFICATION OF FLASHLIGHT CASES

A simplified practice recommendation covering sizes and finishes of flashlight cases was adopted by a general conference of manufacturers, distributors, and users of this commodity held at the Department of Commerce on April 27, resulting in an elimination of approximately 40 per cent of varieties. The recommendation is to be effective for new production December 31, 1927. A standing committee is to be appointed by the National Committee on Metals Utilization to sponsor the simplification and to revise or modify the recommendation periodically as conditions dictate.

SIMPLIFICATION OF RAZOR-BLADE PACKAGES

A general conference of manufacturers, distributors, and users of razor blades was held in New York City on March 31 to consider the desirability of simplifying the packing of razor blades. A simplified practice recommendation covering a standard schedule for packaging was approved, and the matter is now before the industry for final acceptance. Recommendation for packing blades by decimal system will go into effect July 1, 1928.

SIMPLIFICATION AND STANDARDIZATION IN MANUFACTURE OF MUSICAL INSTRUMENTS

Simplification and standardization received special attention at a meeting of the Musical Instrument and Accessories Manufacturers held in Buffalo March 3 and 4. H. C. Lomb, president, Waverly Musical Products Company (Inc.), New York, N. Y., and chairman of the standardization committee, was instructed to proceed with the standardization of guitars and mandolins, both bowl shape and flat. The committee was also authorized to withhold or recall certificates of standards for instruments

which in its opinion do not conform to reasonable minimum limits of quality of materials, workmanship, or tone, as well as of measurement.

Mr. Lomb also read a paper before the joint session of the wood industries and management divisions of the American Society of Mechanical Engineers on the subject, "What to expect from the application of principles of simplified practice in the music industries." In concluding his paper on this subject, Mr. Lomb made this very significant statement:

"The apprehension that simplification or standardization will destroy individuality rests upon a misconception of the purpose of simplification. Simplification aims only at the elimination of the superfluous, the nonessential. It really enhances the individuality of any given product by fixing the attention on those features which promote the distinctiveness of the product while simultaneously preventing attempts at individuality where it would be superficial and useless."

STANDARDIZATION OF FIRE-HOSE THREADS

A bill has been introduced in the Legislature of Texas to appropriate \$5,000 a year for two years to provide a fund to standardize the hose threads in the various cities and towns in the State. The bill has been reported, favorably, and it is believed that it will pass the legislature.

At the present time there are 352 protected cities and towns in Texas, 75 of which have standard threads, 209 with threads which will be easily adaptable, and 59 with threads which will probably have to be changed. Because of the large area of the State and the wide distribution of the towns a large amount of work will be necessary before the threads are rechased to conform to a definite standard.

STANDARDS YEARBOOK

In the April number of the Technical News Bulletin mention was made of the new Standards Yearbook which was then

in press. This publication was released on April 19, and since that time it has met with a ready sale. Apparently many manufacturers, industrial experts, engineers, purchasing agents, and libraries have found that the book fills a real need.

The free edition was extremely limited, and the initial distribution was confined to agencies which cooperated with the bureau in preparing the book, Government departments, and certain standardizing institutions. However, anyone desiring a copy of the Yearbook can obtain the same by sending \$1 to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Suggestions and criticisms of the Yearbook, the first one ever issued by the bureau, will be gladly received. It is the bureau's desire to make the next issue of even greater value to all those interested in standardization.

DIRECTORY OF COMMERCIAL AND COLLEGE LABORATORIES

The Bureau of Standards makes many tests for the Government, the industries, and the public. Special provision was made for the Government testing in the act creating the bureau. The volume of this work for the Federal Government makes it impracticable for the bureau to carry out tests for private institutions and individuals if commercial laboratories can do the work. To inform interested persons of the location of other laboratories, the bureau has compiled a directory of the 207 commercial testing laboratories throughout the country, together with indications of the types of commodities which they are prepared to test. Special care has been exercised to make this list complete. It has now been issued in printed form as Miscellaneous Publication No. 90 of the Bureau of Standards and may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents per copy. Publication was decided upon because of the desirability of making available to all those interested the location of independent

testing services throughout the country and in anticipation of a marked increase in the demand for such service in domestic and export trade.

Accompanying the list of commercial testing laboratories there is presented a list of the laboratories of 143 colleges which are used not only for purposes of instruction but also to a considerable extent for research work.

It is believed that the existence of this thoroughly classified directory of testing laboratories will have a number of beneficial effects in promoting the use of specifications, not the least important of which will be the inducement offered to the large number of purchasers who have hesitated to buy on specifications in the past because no adequate service for checking the quality of deliveries appeared to exist.

An outline is given of the certification plan, in accordance with which there have already been compiled 48 lists of manufacturers who have expressed their willingness to certify to purchasers that material supplied on orders based on the indicated 48 United States Government Master Specifications complies with the requirements and tests of these specifications.

CALIBRATION OF FREQUENCY STANDARDS FOR BROADCASTING STATIONS

The Bureau of Standards will calibrate a piezooscillator, frequency indicator, or frequency meter for use in maintaining a radio broadcasting station on its assigned frequency upon request of the owner of the station. A nominal fee is charged. Instruments should not be sent to the bureau for calibration without first writing and giving the call letters of the station and its assigned frequency and the type, make, and description of the device to be calibrated. Information as to the type and make of the device will assist in deciding whether the instrument can be accepted for test and may save returning the device to the maker for changes in construction. The bureau can accept for calibration only instruments which

are properly constructed and likely to maintain their calibration.

Specifications for a piezooscillator and for a frequency indicator can be obtained by addressing the radio section of the Bureau of Standards. A more sensitive resonance indicator has recently been devised for the bureau's type B frequency indicator. The radio-frequency thermogalvanometer has been replaced by a crystal detector and direct current milliammeter. The latter combination shows smaller changes in frequency than the thermogalvanometer.

THE NEW WORD, "KILOCYCLE"

A word somewhat new to the radio public was introduced into radio station announcements by order of the Federal Radio Commission during the past month. This is evidence that the commission is being guided in its decisions by the public interest. The decision to replace meters by kilocycles is in line with scientific accuracy as well as greater convenience to the public. The original use of wave lengths and meters was really a mistake, has caused much confusion, and has been an obstacle in the path of the serious-minded who sought to learn the principles of radio. The public has continued to use meters simply because the habit got started and for no other reason.

It is much easier for the radio listener to log the stations on his dials in kilocycles, because for adequate technical reasons all station frequencies are in even numbers, 620, 630, etc., spaced 10 kilocycles apart. The wave-length ratings, on the other hand, such as 483.6, 475.9, are troublesome and are separated by different amounts all over the scale. In selecting the even kilocycle ratings the commission is utilizing the results of several years' experience in the development of broadcasting. Spacings other than the uniform 10 kilocycles between stations have been tried and have always added to interference. The inherent reason for this is that the radio wave carrying speech or music does not occupy a single sharp frequency but actually occu-

pies a little band of frequencies 10 kilocycles wide.

The word "kilocycle" need cause no dismay. "Kilo" means "thousand," and is familiar to everyone in "kilowatt," which means a thousand watts. The other part of the word "cycle" means one complete alternation. The number of kilocycles is the number of thousands of times that the rapidly alternating current in the antenna or the set repeats its flow in either direction in one second.

When it is necessary to find out the approximate kilocycle rating corresponding to a certain number of meters, or vice versa, it is done by dividing 300,000 by the number. For example, 300 meters corresponds to 1,000 kilocycles, and also 300 kilocycles corresponds to 1,000 meters. For exact conversion the factor to be used is not exactly 300,000, but 299,820. A table to facilitate conversion, eliminating all calculation, has been prepared by the Bureau of Standards. It is Miscellaneous Publication No. 67, "Kilocycle-Meter Conversion Table," and is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents. In view of the action of the commission, however, there will probably be very little occasion for anyone to make any use of "meters," and the need for making the conversion from one to the other will disappear.

While "kilocycle" is a new word to many radio listeners, it is an established term in radio engineering. On account of its greater convenience and because the wave-length designation is secondary, confusing, and superfluous, engineers have gone increasingly to the kilocycle basis in the past four years, and manufacturers have more and more inclined to marking their dials in kilocycles rather than meters. The use of kilocycles was given standing as authoritative American practice when, on the recommendation of the Bureau of Standards representatives, the 1923 National Radio Conference adopted a resolution that stations be rated in kilocycles. The definite adoption of this

practice by the Federal Radio Commission is in harmony with the trend of the best radio engineering and manufacturing.

PROTECTING AIRCRAFT AGAINST CORROSION

One of the greatest drawbacks in constructing airplanes and airships from the light, strong, aluminum alloy (duralumin) is the fact that on exposure, especially to salt air, the alloy, particularly when in sheet or other thin forms, may become brittle through a type of corrosion which is not apparent on the surface and which, therefore, can not be detected upon inspection. This sort of corrosion weakens the bond between the crystal grains that make up the alloy and so is termed "intercrystalline embrittlement." The tiny, submicroscopic particles, which give the alloy its desirable properties, tend to collect at the grain boundaries. If this collection at the boundaries can be avoided, the tendency toward embrittlement is reduced.

In commercial practice the alloy is generally heated in a bath of fused salts (nitrates) and quenched for heat treatment in boiling water; boiling water being used because the adhering salt is more readily dissolved than in cold water. On the other hand, the greater speed of quenching in cold water minimizes the time for collection of the hard particles at the grain boundaries and hence markedly increases the resistance to intercrystalline corrosion.

Work of the past two years at the bureau in cooperation with the Navy, Army, and National Advisory Committee for Aeronautics has shown that, in laboratory corrosion tests, duralumin quenched in cold water is markedly superior to that quenched in hot water or oil, but even this does not fully solve the problem, and protection of the surface of the duralumin is also advisable.

Many types of protective coatings have been tried, several of which appear quite effective. Few coatings of the paint or varnish type, however, are completely impervious to moisture, and most of them tend to crack or blister with

age, thus losing their adhesion and some of their protective power. However, commercially pure aluminum is not subject to intercrystalline embrittlement because it does not contain the hardening particles that tend to create a pathway for the intercrystalline attack.

Hence, if an adherent coating of unalloyed aluminum be provided over the duralumin, good protection is afforded. This idea, evolved at the bureau some three years ago, was tried out in laboratory tests. Duralumin, so protected, proved superior to that protected in other ways, because the aluminum coating will stand more scratching without baring the duralumin. Specimens coated with aluminum by the metal-spray process have been exposed to salt air for a year without deterioration.

Reports of the good behavior of aluminum-coated duralumin have been made to the cooperating agencies, have been briefly commented on before,¹ and the information has been available to producers of duralumin. It is gratifying to note that one of the chief producers of duralumin has, by independent laboratory tests, corroborated the bureau's experience as to the good performance of aluminum-coated duralumin in resistance to corrosion and is just starting to make commercially available duralumin in sheets coated with aluminum by a process which the manufacturer has worked out, but which has not yet been described in detail. The product is of the same general type, however, as that which the bureau has tested extensively.

It therefore appears that by cold-water quenching, by the use of aluminum coatings, and by the use of various protective films, varnishes, grease coatings, etc., as a further insurance against corrosion, the greatest drawback to long life and safety of duralumin for aircraft construction may be almost completely eliminated, and by means that are commercially practical.

AIRSHIP FABRIC CONFERENCE

A conference was held on May 3 at the Bureau of Standards to consider air-

ship cloth. Representatives of the Navy Department, National Advisory Committee for Aeronautics, fabric manufacturers, and fabric finishers were present.

The exchange of information permitted definite agreement and recommendations to be made on several particulars which have been causing much difficulty in the procurement of this material.

The discussion centered on the HH cloth which is a 2-ounce, 134 by 134 count fabric. Tolerances of 5 per cent on the strength and $2\frac{1}{2}$ per cent on the weight requirements were recommended. The method for obtaining breaking strength was changed to conform with the usual practice for this type of material. Other minor changes were adopted.

Since the bureau had the cooperation of the Government departments concerned in the purchase of this material it is believed that the recommendations of this conference will be accepted and utilized in future purchases.

EFFECT OF RELATIVE HUMIDITY AND TEMPERATURE ON THE TENSILE PROPERTIES OF VULCANIZED RUBBER COMPOUNDS

The cooperative work between the bureau and the American Chemical Society in studying the effect of relative humidity and temperature on the tensile properties of vulcanized rubber was announced in Technical News Bulletin No. 118. One phase of the problem has been completed. The study of 5 compounds, each at 5 states of cure, was made at 5 temperatures ranging from 5 to 45° C., and at 6 humidities ranging from 0 to 100 per cent relative humidity.

The results show that the temperature of the testing room should be controlled within 1° or 2°, and that relative humidity also should be controlled to some extent. It is probable that a control of relative humidity within a range of 10 per cent (plus or minus 5 per cent) would be satisfactory.

There is no evidence that state of cure influences to any great extent the effect of either temperature or relative hu-

¹ Forging, Stamping, Heat Treating, Vol. 12, p. 373; October, 1926.

midity. Gum stocks seem to be affected slightly more than heavily compounded stocks. The effect of relative humidity and temperature was not influenced by the type of accelerator or the softener used in the compound.

The first phase of the work consisted in a study of the effect of humidity and temperature after vulcanization and during testing. The compounds were conditioned two and six days. Two days represents the usual time in commercial practice, while the six-day exposures were made to get nearer the maximum effect.

The next phase of the work is to determine the effect of humidity and temperature upon the unvulcanized compounds. The compounds will be mixed at the bureau and carefully conditioned over ranges of relative humidity and temperature before vulcanization. After vulcanization the specimens will receive uniform conditioning as to temperature and humidity to determine the effect of the varying conditions previous to vulcanization.

The results in detail will be reported to the rubber section of the American Chemical Society when the second phase of the work has been completed.

MANILA ROPE WASTE FOR PAPER MANUFACTURE

Paper-making tests have recently been made at the Bureau of Standards to determine the suitability of manila rope waste for paper manufacture. The waste employed in the experimental work was refuse fiber from the manufacture of manila cordage at the rope walk of the Boston Navy Yard. At present little, if any, of the waste derived from manila hemp at cordage mills is used commercially, most of it being burned under the boilers as fuel. The experimental tests were made with a view to finding a profitable use for the refuse fiber of the cordage industry.

Manila hemp (*musa textilis*) is obtained from the leaf stalks of a plant of the banana family and is one of the principal products of the Philippine Islands. The fiber is tough and strong

and is used primarily for textiles and cordage. The material used in the paper industry is obtained almost entirely in the form of old rope, and the papers produced from it are commonly called "rope" papers. Rope papers are characterized by great strength, toughness, and wearing qualities, and are ordinarily used for shipping tags, wrappers, bagging, etc., in which strength is essential.

The pulping and paper-making operations employed in the experimental tests on the waste were those commonly used in paper manufacture. Soda ash was the digesting agent that gave best results. Tests on kraft and sulphite wood pulps and on old rope stock were included for comparison. A good yield of paper was obtained from the waste, and the paper produced was of sufficient strength for a variety of uses. Measurements on the finished paper indicate that manila rope waste does not compare favorably with old rope stock but is considerably better than sulphite wood pulp.

A complete report of this work was published in *Paper Trade Journal*, May 5, 1927.

NEW METHOD FOR DETERMINING SOUNDNESS OF HYDRATED LIME

The present standard method of the American Society for Testing Materials for determining the soundness of hydrated lime requires a minimum time of three days for completion, and the specifications permit much variation in check tests on the same sample. It would obviously be desirable to have a method which could be conducted in much less time with more nearly uniform results. Recently the bureau investigated a method suggested, which consisted essentially of the duplication on small, thin specimens of the process used in the manufacture of sand-lime brick.

The test pieces used in the work were 1 by 4 by $\frac{3}{4}$ inches, and the proportions of sand to hydrated lime were 9:1 by weight. A sufficient quantity of water to give a mixture which retained its shape when pressed in the hand was used, and in practically all cases approximated 10 per cent of the combined

weight of the sand and lime. The pressure used in making the test pieces was 10,000 pounds per square inch for the major portion of the work and 6,000 pounds per square inch for the remainder. The specimens made with the lower pressure were more difficult to handle without breaking, but the results on those not broken were just as accurate as upon those made with the higher pressure. The specimens were then steamed in an autoclave at 140 pounds per square inch pressure for five hours.

Specimens which contained unsound lime in the slightest degree completely disintegrated or cracked badly during the steaming process, and in every instance where the lime was unsound by the usual test the sand-lime brick test corroborated the results. It was, therefore, concluded that the sand-lime brick method is fully as accurate as the present standard method, while the time required for the completion of a test of lime for soundness is only one-third. The equipment necessary for the sand-lime brick test is quite simple, and should be easily obtained by any lime manufacturer or testing laboratory. A small hand press which would give the required pressure and an autoclave having a steam gauge are all that are required. The autoclave may be made from a section of large pipe, such as is used for high-pressure steam lines.

While in the autoclave the test specimens should be carefully covered to prevent condensed moisture from dripping upon them. A well-dried brick large enough to cover the top specimen will serve for this purpose.

At the next meeting of the Lime Committee of the American Society for Testing a Materials it is proposed to bring this new method of evaluating lime to the attention of the committee.

LIGHT COLORED FIRST-COAT ENAMELS FOR SHEET IRON

It is very common practice in the manufacture of vitreous enamel-coated sheet iron and steel articles to apply first a coating which is a dark color, and over this to apply two coats of

white enamel to give the desired brilliant white finish. The first coat is dark because it contains cobalt and other oxides which enhance its ability to adhere to the iron, but if a white first coat can be applied which is sufficiently adhesive a total of two coats will suffice and a saving in manufacturing costs results. There is now in progress at the bureau an investigation to eliminate the necessity for the dark first coat, either through development of a light-colored enamel which by virtue of its composition has an adhesiveness comparable to that of a cobalt enamel, or through improving the technique of application so that a white enamel will adhere sufficiently, or both.

Several different opacifying materials, added in the raw state to the enamel glass before grinding, have been studied to determine their suitability for use in a first coat. These materials included tin oxide, zirconium oxide, zirconium silicate, and sodium antimonate. Of these sodium antimonate and zirconium oxide gave promise of satisfactory behavior for this use.

Since the problem is intimately concerned with adherence of enamels, the development of a test of adherence has been undertaken. Iron plates, 1 by 3 inches, are sprayed with enamel and placed in the furnace on a special rack designed so that one of the plates is about $\frac{1}{8}$ inch above the other with an overlap of 1 inch. When the enamel is matured, the pieces are clamped together with special tongs, so designed that the same pressure will be exerted every time. After cooling the adhering pieces, having a contact area of 1 square inch, are pulled apart just as if the tensile strength of the iron were being tested. Sometimes the failure occurs in the enamel itself and sometimes in the bond between the enamel and the iron. Although the test has not been completely developed, it shows promise of giving valuable relative data.

DRYING AND FIRING OF CLAYS

A report on this subject is now in course of preparation and will contain

correlated data from three separate investigations. The first phase is confined to removal of moisture at and below 110°C ., as previously reported in Technical News Bulletins Nos. 101, 107, and 113. The second phase covers the so-called water smoking or removal of hygroscopic and chemically combined water, and the third phase covers an investigation conducted on plant kilns and which concerns not only problems of dehydration of clay but also oxidation.

From a consideration of information as brought out in the three investigations it would seem that materials of the fire-clay type are much more difficult to dry than the shales, but the temperature ranges of water smoking were more clearly defined for the fire clays than for the shales. Although the dehydration and oxidation of the shales appeared to be somewhat more sluggish than for the fire clays, there was no great difference in the time and temperature required for either type of material to reach final constant weight.

The results of the laboratory dehydration tests are being correlated satisfactorily with the observations and conclusions reached in the tests of commercial kilns, and it will probably be possible to predict, from data obtained in the laboratory, whether or not a clay could be dried and fired easily under commercial conditions and, if not, at what stages it would be necessary to use caution.

Probably the most important point brought out as a result of the work is that water smoking (the removal of hygroscopic and chemically combined water) offers no difficulty in itself, but that the time required to fire ware is controlled by the relative ease with which the ware can be dried (the removal of shrinkage and pore water) and

oxidized. It is believed that the difficulty encountered in firing ware is not caused by the removal of hygroscopic and chemically combined water, as initially contained in the clay, but rather by the water which has been driven out of the ware in the hotter portions and which may be reabsorbed by the ware in the colder portions and soften the ware sufficiently to cause kiln marking and cracking. It may also recombine as shrinkage water, and its removal in this form might easily cause cracking if the clay is of the "difficult drying" type.

While the preparation of the report is nearing completion, it will probably be several months before it is published and available for distribution.

PROGRESS OF CHINA-CLAY INVESTIGATION

At the Columbus branch of the bureau a study is being made of English and American china clays for the purpose of comparing the two and finding to what extent American clays can be used to supplant English clays. Thus far only the English clays have been studied. Seventeen different brands were selected for which, to date, the following properties have been evaluated: Water of plasticity, shrinkage water, pore water, volume shrinkage, slaking time, bulk and true specific gravity, modulus of rupture, particle size distribution and hydrogen-ion concentration on the clays dried at 110°C . and volume shrinkage, modulus of rupture, porosity, bulk and true specific gravity on the clays fired to cones 3, 5, 8, 11, and 14.

The most recent work has been the determination of true specific gravity. In the following table values are shown for the average of the 17 clays under each of the six different conditions, and the maximum and minimum variations therefrom in per cent of the average:

	Dry	Cone 3	Cone 5	Cone 8	Cone 11	Cone 14
Average.....	2.632	2.609	2.703	2.716	2.724	2.709
Maximum variation.....	.44	1.01	.77	.83	.07	1.33
Minimum variation.....	.48	.80	.85	.79	.93	.90

It will be observed that the variation is extremely slight, considering that the clays used cover practically the entire range of the English china clays. The increase of specific gravity up to cone 11 is probably caused by the decomposition of the clay molecule with the formation of mullite which has a specific gravity of 3.15. The drop from cone 11 to cone 14 might be explained by the fact that at 1,250° C. quartz has a transition point, passing from beta quartz to beta cristobalite, the latter having a specific gravity of 2.33. Although cone 11 is 100° above 1,250, it is believed that the temperature of the specimens lagged appreciably behind that of the cones. Microscopic examination which is yet to be made will assist materially in confirming the presence of these minerals and their relative amounts.

At present specimens are being made for firing to cones 18 and 23 (1,490 and 1,590° C.) for the purpose of evaluating the properties at these temperatures. Thermal expansion of specimens fired to various cones is yet to be determined for a range of temperature between 0 and 1,000° C. This work will be done by the use of an interferometer.

The investigation affords opportunity for much study and the development of new tests, as no one of the properties yet studied seems to show the fundamental differences between English and American china clays.

NEW PUBLICATIONS

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1926)

Scientific Papers²

S545. Determination of the magnetic induction in sheet steel; Raymond L. Sanford and James M. Barry. Price, 10 cents.

Volume 20, Scientific Papers of the Bureau of Standards; Nos. 498 to 533 (bound in cloth). Price, \$2.

Technologic Papers²

T336. Comparative tests of six-inch cast-iron pipes of American and French manufacture; S. N. Petrenko. Price, 15 cents.

T339. Use of sulphite cellulose extract as a tanning material (including 12 samples of leather of various tan-nages); E. L. Wallace and R. C. Bowker. Price, 30 cents.

Volume 20, Technologic Papers of the Bureau of Standards; Nos. 302 to 327 (bound in cloth). Price, \$2.

Simplified Practice Recommendations²

R62. Metallic cartridges. Price, 5 cents.

Miscellaneous Publications²

M90. Directory of commercial testing and college research laboratories. Price, 15 cents.

Technical News Bulletin²

TNB122. Technical News Bulletin, June, 1927.

OUTSIDE PUBLICATIONS²

A digest of the literature on the constitution of Portland cement clinker. R. H. Bogue; Paper No. 3, Portland Cement Association Fellowship (Care of Bureau of Standards, Washington, D. C.); February, 1927.

Studies on the system lime-alumina-silica. The composition $8\text{CaO} + \text{Al}_2\text{O}_3 + 2\text{SiO}_2$. W. C. Hansen, W. Dyckerhoff, F. W. Ashton, and R. H. Bogue; Paper No. 6, Portland Cement Association Fellowship (Care of Bureau of Standards, Washington, D. C.); April, 1927.

² Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States, Canada, and Mexico), 40 cents (foreign).

² "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

- Portland cement in concrete engineering. R. H. Bogue; Paper No. 9, Portland Cement Association Fellowship (Care of Bureau of Standards, Washington, D. C.); March, 1927.
- Analysis of hydrated lime by a thermochemical method. D. F. Richardson; Industrial and Engineering Chemistry (Washington, D. C.), Vol. 19, No. 5, p. 625; May, 1927.
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- The microstructure of earthenware. Herbert Insley; Journal of the American Ceramic Society (Columbus, Ohio); Vol. 10, No. 5, p. 317; May, 1927.
- Specifications for wire rope for mines. H. L. Whittemore, Published by American Engineering Standards Committee (New York, N. Y.); April, 1927.
- Comments on shear test results. H. L. Whittemore, Fifth progress report, Journal American Welding Society (New York, N. Y.), Vol. 6, No. 3, p. 56; March, 1927.
- Suggested program for strain-gauge measurements of welded rail joints. H. L. Whittemore, Fifth progress report, Journal American Welding Society (New York, N. Y.); Vol. 6, No. 3, p. 68; March, 1927.
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- The curl sizing tester. F. T. Carson; The Paper Industry (New York, N. Y.); Vol. 9, No. 2, p. 259; May, 1927.
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- The highway and the laboratory. George K. Burgess; Proceedings sixth annual meeting, Highway Research Board (Care of National Research Council, Washington, D. C.); December 2 and 3, 1926, p. 20; Published May, 1927.
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